CLAIMS

What is claimed is:

1. A method for fabricating multi-element apparatus configured to simultaneously focus a plurality of wavebands in an approximately identical focal plane, wherein said method comprises the steps of:
    - i. selecting a plurality of materials having unique indices of refraction and known refractive behavior for the plurality of wavebands;
    - ii. configuring the materials such in the form of an apparatus wherein the shape of said apparatus may be predicted using successive approximation techniques to generate aspheric lens surfaces for ideal focii in one of the wavebands, and then confirm the solutions by ray tracing with Snell's law in both bands.

2. A method for fabricating multi-element apparatus of claim 1 wherein the plurality of wavebands comprise millimeter waves and infrared radiation, wherein:
    - i. millimeter waves are between 30GHz and 300GHz; and
    - ii. infrared radiation is between 0.75 and 750 micrometers

3. A method for fabricating multi-element apparatus of claim 1 wherein:
    - i. a first element consists essentially of zinc sulfide; and

ii. a second element consists essentially of zinc selenide.

4. A method for fabricating multi-element apparatus of claim 1 wherein:
   i. a first element consists essentially of zinc selenide; and
   ii. a second element consists essentially of zinc sulfide.

5. A method for fabricating multi-element apparatus of claim 1 wherein a second surface geometry of a first element and a first surface geometry of a second element are spaced a variable distance apart, wherein said distance is selected to optimize the multiple waveband focusing properties of the apparatus and wherein the exposed lens' surfaces are coated with an antireflective coating.

6. A method for fabricating multi-element apparatus of claim 1 wherein:
   i. a first element consisting essentially of zinc selenide and having an index of refraction of approximately 2.43 for the millimeter wave region and approximately 3.01 for infrared region and having a first and second surface, wherein the first and second surfaces have geometries;

   ii. a second element having an index of refraction of approximately 2.25 for the millimeter wave region and approximately 2.90 for the infrared region and having a first and second surface, wherein the first and second surfaces have geometries; and

iii. wherein the second surface geometry of the first element and the first surface geometry of the second element possess substantially identical but inverted geometries and conform to produce an interface between said second surface geometry of the first element and the first surface geometry of the second element, and

iv. wherein the first element has a 30-cm aperture and 71-cm focal length for both the millimeter wave and infrared regions.

7. A method for designing a lens configured to simultaneously focus a plurality of wavebands, comprising the steps of:
   i. selecting a plurality lens materials wherein said materials are at least partially transparent to the plurality of wavebands;
   ii. use thin lens formulae to generate initial values for a plurality of thick lens parameters;
   iii. specify, a priori, a plurality of initial values for a plurality of thick lens parameters;

iv. iteratively vary the image point position, lens surface, and lens thickness until a first lens configuration is found that provides substantial convergence of a first waveband at an image point;

v. constrain a plurality of the iterated values, including the focal point and object point and iteratively vary the lens shapes and thickness until a second lens configuration is found that provides substantially convergence in the second waveband; and

vi. combine the properties of the first and second lens, so as to optimize the dual waveband convergence.

8. A method for designing a lens according to claim 7, wherein the dual wavebands are substantially confined to infrared and mm-wave waveband regions, and wherein the final lens configuration is optimized to provide an input to a focal plane array.

9. A method for designing a lens according to claim 8, wherein the solutions provided in step vi are confirmed by ray tracing in both bands, using Snell's law.

10. A method for designing a lens according to claim 7, wherein the lens configuration is optimized for the IR waveband region.

11. A method for designing a lens according to claim 7, wherein the plurality of lens materials includes ZnSe and ZnS, and the lens is provided with an antireflective coating.

12. A method for designing a lens according to claim 7, wherein a plurality of two component lenses are used to optimize focusing in the IR and mm-wave wavebands.